

## **AMENDMENTS TO THE CLAIMS**

This listing of claims will replace all prior versions, and listings, of claims in the application:

### **Listing of Claims:**

- 1           1.       (Currently Amended) A computer-implemented method of adding  
2       a new node to a network multicast group, with a specified group membership  
3       status, wherein members of a corresponding routing tree ~~are configured to route~~  
4       multicast messages among members of the group, the method comprising:  
5               selecting a minimum spanning tree of the network;  
6               selecting the new node as the current node;  
7               examining the routing tree membership statuses of nodes that are linked to  
8       the current node by links included in the minimum spanning tree;  
9               until said examining is halted, selecting a peer node of the current node as  
10      the current node and repeating said examining;  
11              halting the examining when a final node is examined if:  
12                  the final node is a Full member of the routing tree; or  
13                  the final node is a SendOnly member of the routing tree and the  
14              specified group membership status of the new node is SendOnly; and  
15              for each given node in the path from the new node to the final node,  
16      setting the routing tree membership status of the given node equal to the specified  
17      group membership status of the new node.
- 1           2.       (Original) The method of claim 1, further comprising:  
2              maintaining a queue for storing network nodes for selection as current  
3      node;

4           wherein a first peer of a current node is added to said queue if:  
5                 said first peer is coupled to the current node by a link included in  
6           the minimum spanning tree;  
7                 said first peer is not a Full member of the routing tree; and  
8                 the routing tree membership status of said first peer and the  
9           specified group membership status of the new node are not both  
10          SendOnly.

1           3.       (Original) The method of claim 2, further comprising:  
2           determining if said queue is empty if:  
3                 the specified group membership status of the new node is Full; and  
4                 the routing tree membership status of said first peer is SendOnly.

1           4.       (Original) The method of claim 2, further comprising:  
2           halting the examining if said queue is empty.

1           5.       (Currently Amended) A computer readable medium storing  
2           instructions that, when executed by a computer, cause the computer to perform a  
3           method of adding a new node to a network multicast group, with a specified group  
4           membership status, wherein members of a corresponding routing tree ~~are~~  
5           ~~configured to route multicast messages among members of the group, the method~~  
6           comprising:  
7                 selecting a minimum spanning tree of the network;  
8                 selecting the new node as the current node;  
9                 examining the routing tree membership statuses of nodes that are linked to  
10          the current node by links included in the minimum spanning tree;  
11                 until said examining is halted, selecting a peer node of the current node as  
12          the current node and repeating said examining;

13            halting the examining when a final node is examined if:  
14                the final node is a Full member of the routing tree; or  
15                the final node is a SendOnly member of the routing tree and the  
16                specified group membership status of the new node is SendOnly; and  
17                for each given node in the path from the new node to the final node,  
18        setting the routing tree membership status of the given node equal to the specified  
19        group membership status of the new node.

1            6.        (Currently Amended) A computer-implemented method of adding  
2        a first node to a multicast group of network nodes, wherein members of a  
3        corresponding routing tree ~~are configured to route~~ multicast messages among  
4        members of the group, the method comprising:  
5                (a)        receiving a first request to include a first network node in a  
6        multicast group as one of a Full member and a SendOnly member;  
7                (b)        setting a GroupStatus of the first node according to the first  
8        request, wherein said GroupStatus indicates a membership status in the multicast  
9        group;  
10                (c)        selecting a minimum spanning tree of the network;  
11                (d)        selecting the first node as the current node;  
12                (e)        selecting a peer node of the current node, wherein a TreeStatus of  
13        the selected peer has not been examined since the first request was received,  
14        wherein said TreeStatus indicates a membership status in the routing tree;  
15                (f)        performing one or more of the following examinations:  
16                        (f1)        determining if said TreeStatus of the selected peer is Full;  
17                        (f2)        determining if said TreeStatus of the selected peer is  
18                        SendOnly and said GroupStatus of the current node is SendOnly; and  
19                        (f3)        determining if a network link coupling the current node to  
20                        the selected peer is part of the selected minimum spanning tree;

21 (g) repeating steps (e) — to steps (g) until one of:  
22 (g1) at least one peer of the current node has been examined;  
23 and  
24 (g2) one of said step (f1) and said step (f2) determinations  
25 succeed;  
26 (h) if neither of said step (f1) and said step (f2) determinations has  
27 succeeded, setting a peer of the current node as the current node;  
28 (i) repeating steps (e) — to steps (h) until one of:  
29 (i1) all nodes in the routing tree have been examined; and  
30 (i2) one of said step (f1) and said step (f2) determinations  
31 succeed;  
32 (j) for each given node in the minimum spanning tree, from the new  
33 node to the last peer examined, setting a TreeStatus of the given node equal to  
34 said GroupStatus of the new node.

1 7. (Currently Amended) The method of claim 6, further comprising,  
2 after step (d):  
3 comparing said GroupStatus of the first node to said TreeStatus of the first  
4 node.

1 8. (Original) The method of claim 6, further comprising:  
2 maintaining a queue in which to queue nodes for selection as the current  
3 node.

1 9. (Currently Amended) The method of claim 8, further comprising, if  
2 said step (f3) determination succeeds:  
3 adding the selected peer to said queue.

1           10.     (Currently Amended) The method of claim 9, further comprising, if  
2     said step (f3) determination succeeds:  
3           if said TreeStatus of the selected peer is SendOnly and said GroupStatus of  
4     the new node is Full, determining if said queue is empty.

1           11.     (Currently Amended) A computer readable medium storing  
2     instructions that, when executed by a computer, cause the computer to perform a  
3     method of adding a first node to a multicast group of network nodes, wherein  
4     members of a corresponding routing tree ~~are configured to route~~ multicast  
5     messages among members of the group, the method comprising:  
6           (a)     receiving a first request to include a first network node in a  
7     multicast group as one of a Full member and a SendOnly member;  
8           (b)     setting a GroupStatus of the first node according to the first  
9     request, wherein said GroupStatus indicates a membership status in the multicast  
10    group;  
11          (c)     selecting a minimum spanning tree of the network;  
12          (d)     selecting the first node as the current node;  
13          (e)     selecting a peer node of the current node, wherein a TreeStatus of  
14    the selected peer has not been examined since the first request was received,  
15    wherein said TreeStatus indicates a membership status in the routing tree;  
16          (f)     performing one or more of the following examinations:  
17                  (f1)     determining if said TreeStatus of the selected peer is Full;  
18                  (f2)     determining if said TreeStatus of the selected peer is  
19                  SendOnly and said GroupStatus of the current node is SendOnly; and  
20                  (f3)     determining if a network link coupling the current node to  
21                  the selected peer is part of the selected minimum spanning tree;  
22          (g)     repeating steps (e) — to steps (g) until one of:  
23                  (g1)     at least one peer of the current node has been examined;

24           and  
25               (g2)   one of said step (f1) and said step (f2) determinations  
26           succeed;  
27           (h)   if at least one peer of the current node has been examined, setting a  
28   peer of the current node as the current node;  
29           (i)   repeating steps (c) — to steps (h) until one of:  
30               (i1)   all nodes in the routing tree have been examined; and  
31               (i2)   one of said step (f1) and said step (f2) determinations  
32           succeed;  
33           (j)   for each given node in the minimum spanning tree, from the new  
34   node to the last peer examined, setting a TreeStatus of the given node equal to  
35   said GroupStatus of the new node.

1           12.   (Currently Amended) A computer-implemented method of adding  
2   a new node to a network multicast group, with a specified group membership  
3   status, wherein members of a corresponding routing tree ~~are configured to route~~  
4   multicast messages among members of the group, the method comprising:  
5           identifying a minimum spanning tree of the network;  
6           selecting the new node as the current node;  
7           until a final node having a routing tree membership status greater than or  
8   equal to the specified group membership status of the new node is identified,  
9   repeating:  
10           examining the routing tree membership statuses of peer nodes of  
11           the current node; and  
12           selecting as current node a peer node of the current node that is  
13           coupled to the current node by a link included in the minimum spanning  
14           tree; and  
15           setting the routing tree membership status of each node in the minimum

16 spanning tree, from the new node to the final node, to the specified group  
17 membership status of the new node.

1 13. (Original) The method of claim 12, wherein a node's routing tree  
2 membership status and group membership status are each one of the following,  
3 from lesser status to greater status: non-member, SendOnly, Full.

1 14. (Currently Amended) A computer readable medium storing  
2 instructions that, when executed by a computer, cause the computer to perform a  
3 method of adding a new node to a network multicast group, with a specified group  
4 membership status, wherein members of a corresponding routing tree ~~are~~  
5 ~~configured to route multicast messages among members of the group, the method~~  
6 comprising:

7 identifying a minimum spanning tree of the network;  
8 selecting the new node as the current node;  
9 until a final node having a routing tree membership status greater than or  
10 equal to the specified group membership status of the new node is identified,  
11 repeating:

12 examining the routing tree membership statuses of peer nodes of  
13 the current node; and

14 selecting as current node a peer node of the current node that is  
15 coupled to the current node by a link included in the minimum spanning  
16 tree; and

17 setting the routing tree membership status of each node in the minimum  
18 spanning tree, from the new node to the final node, to the specified group  
19 membership status of the new node.

1 15. (Currently Amended) A computer-implemented method of

removing a first node from a network multicast group, wherein members of a corresponding routing tree ~~are configured to route~~ multicast messages among members of the group, the method comprising:

- queuing the first node in a queue;
- until the queue is empty, repeating the following, in order:
  - (a) removing the most recently queued node to serve as the current node;
  - (b) returning to step (a) if the group membership status of the current node is Full;
  - (c) identifying a number of local ports of the current node that are on;
  - (d) returning to step (a) if the number is greater than one;
  - (e) if the number of local ports that are on is equal to zero:
    - (e1) for each peer node having a local port to the current node on, turning off said peer node's local port to the current node and adding said peer node to the queue; and
    - (e2) setting the routing tree membership status of the current node to None; and
  - (f) if the number of local ports that are on is equal to one:
    - (f1) on a sole peer node coupled to the one local port, turning off the sole peer node's local port to the current node if the sole peer's local port to the current node is on;
    - (f2) adding the sole peer node to the queue;
    - (f3) if zero peer nodes have local ports to the current node on and the group membership status of the current node is None:
- turning off the one local port of the current node that is on; and



30                                setting the routing tree membership status of the  
31                                current node to None; and  
32                                (f4)    otherwise, setting the routing tree membership  
33                                status of the current node to SendOnly.

1                16.    (Currently Amended) The method of claim 15, further comprising,  
2    prior to said repeating of steps (a) to steps (f):  
3                setting the group membership status of the first node to one of None and  
4    SendOnly.

1                17.    (Currently Amended) A computer readable medium storing  
2    instructions that, when executed by a computer, cause the computer to perform a  
3    method of removing a first node from a network multicast group, wherein  
4    members of a corresponding routing tree ~~are configured to route~~ multicast  
5    messages among members of the group, the method comprising:  
6                queuing the first node in a queue;  
7                until the queue is empty, repeating the following, in order:  
8                (a)    removing the most recently queued node to serve as the  
9                current node;  
10                (b)    returning to step (a) if the group membership status of the  
11                current node is Full;  
12                (c)    identifying a number of local ports of the current node that  
13                are on;  
14                (d)    returning to step (a) if the number is greater than one;  
15                (e)    if the number of local ports that are on is equal to zero:  
16                (e1)    for each peer node having a local port to the current  
17                node on, turning off said peer node's local port to the current node  
18                and adding said peer node to the queue; and

19 (e2) setting the routing tree membership status of the  
20 current node to None; and  
21 (f) if the number of local ports that are on is equal to one:  
22 (f1) on the sole peer node coupled to the one local port,  
23 turning off the sole peer node's local port to the current node if the  
24 sole peer's local port to the current node is on;  
25 (f2) adding the sole peer node to the queue;  
26 (f3) if zero peer nodes have local ports to the current  
27 node on and the group membership status of the current node is  
28 None:  
29 turning off the one local port of the current node  
30 that is on; and  
31 setting the routing tree membership status of the  
32 current node to None; and  
33 (f4) otherwise, setting the routing tree membership  
34 status of the current node to SendOnly.

1 18. (Currently Amended) A computer-implemented method of  
2 removing a first node from a multicast group of network nodes, wherein members  
3 of a corresponding routing tree ~~are configured to route~~ multicast messages among  
4 members of the group, the method comprising:  
5 receiving a first request to remove a first network node from membership  
6 in a multicast group, wherein the first node was one of a Full member and a  
7 SendOnly member of the multicast group;  
8 setting a GroupStatus of the first node to one of None and SendOnly,  
9 wherein said GroupStatus indicates a membership status in the multicast group;  
10 queuing the first node in a queue;  
11 until the queue is empty, repeating:

12 (a) dequeuing a node from the queue to be the current node;  
 13 (b) determining if the GroupStatus of the current node is Full;  
 14 (c) determining a number of local ports of the current node that are on;  
 15 (d) if the number of local ports is equal to zero:  
 16 (d1) for each peer of the current node with a local port to the  
 17 current node turned on:  
 18 (d1') setting the local port of the peer to off; and  
 19 (d1'') adding the peer to the queue; and  
 20 (d2) setting a TreeStatus of the current node to None, wherein  
 21 said TreeStatus indicates a membership status in the routing tree; and  
 22 (e) if the number is equal to one:  
 23 (e1) on the one peer coupled to the one local port of the current  
 24 node, setting the local port of the one peer to the current node to off;  
 25 (e2) adding the one peer to the queue;  
 26 (e3) if the GroupStatus of the current node is None and zero  
 27 peers of the current node have a local port to the current node on:  
 28 (e3') turning off the one local port of the current node; and  
 29 (e3'') setting the TreeStatus of the current node to None;  
 30 and  
 31 (e4) otherwise, setting the TreeStatus of the current node to  
 32 SendOnly.

1 19. (Currently Amended) The method of claim 18, wherein said step  
 2 (a) comprises:  
 3 dequeuing ~~the a given node~~ most recently added to the queue to be the  
 4 current node.

1 20. (Currently Amended) A computer readable medium storing

instructions that, when executed by a computer, cause the computer to perform a method of removing a first node from a multicast group of network nodes, wherein members of a corresponding routing tree ~~are configured to route~~ multicast messages among members of the group, the method comprising:

receiving a first request to remove a first network node from membership in a multicast group, wherein the first node was one of a Full member and a SendOnly member of the multicast group;

setting a GroupStatus of the first node to one of None and SendOnly, wherein said GroupStatus indicates a membership status in the multicast group;

queuing the first node in a queue;

until the queue is empty, repeating:

(a) dequeuing a node from the queue to be the current node;

(b) determining if the GroupStatus of the current node is Full;

(c) determining a number of local ports of the current node that are on;

(d) if the number is equal to zero:

(d1) for each peer of the current node with a local port to the current node turned on:

(d1') setting the local port of the peer to off; and

(d1'') adding the peer to the queue; and

(d2) setting a TreeStatus of the current node to None, wherein said TreeStatus indicates a membership status in the routing tree; and

(e) if the number is equal to one:

(e1) on the one peer coupled to the one local port of the current node, setting the local port of the one peer to the current node to off;

(e2) adding the one peer to the queue;

(e3) if the GroupStatus of the current node is None and zero peers of the current node have a local port to the current node on:

(e3') turning off the one local port of the current node; and

30 (c3") setting the TreeStatus of the current node to None;  
31 and  
32 (c4) otherwise, setting the TreeStatus of the current node to  
33 SendOnly.

1 21. (Original) A system for managing membership in a multicast group  
2 and a corresponding routing tree for routing multicast messages within the  
3 multicast group, the apparatus comprising:  
4 a network node coupling the apparatus to a network;  
5 a subnet administrator configured to receive requests to change the  
6 membership of the multicast group;  
7 a subnet manager configured to update network nodes' routing tables  
8 when the routing tree is modified in response to a change in membership of the  
9 multicast group; and  
10 a subnet management coordinator configured to:  
11 make a non-member into a Full or SendOnly member of the  
12 multicast group;  
13 make a Full or SendOnly member into a non-member of the  
14 multicast group; and  
15 update the membership of the routing tree in response to a change  
16 in the membership of the multicast group.

1 22. (Original) The system of claim 21, wherein said subnet  
2 management coordinator makes a non-member into a Full or SendOnly member  
3 of the multicast group by:  
4 setting the group membership status of the non-member to the group  
5 membership status specified in a request that was received to make the non-  
6 member a member of the multicast group;

7 identifying a minimum spanning tree of the network;  
8 selecting the non-member as the current node;  
9 until a final node having a routing tree membership status greater than or  
10 equal to the group membership status of the non-member is identified, repeating:  
11 examining the routing tree membership statuses of peer nodes of  
12 the current node; and  
13 selecting as current node a peer node of the current node that is  
14 coupled to the current node by a link included in the minimum spanning  
15 tree;  
16 setting the routing tree membership status of each node in the minimum  
17 spanning tree, from the non-member to the final node, to the specified group  
18 membership status of the new node.

1 23. (Original) The system of claim 22, wherein a node's routing tree  
2 membership status and group membership status are each one of the following,  
3 from lesser status to greater status: non-member, SendOnly, Full.

1 24. (Currently Amended) The system of claim 21, wherein said subnet  
2 management coordinator makes a Full or SendOnly member into a non-member  
3 of the multicast group by:  
4 queuing the member in a queue;  
5 until the queue is empty, repeating the following, in order:  
6 (a) removing the most recently queued member to serve as the  
7 current node;  
8 (b) returning to step (a) if the group membership status of the  
9 current node is Full;  
10 (c) identifying a number of local ports of the current node that  
11 are on;

12 (d) returning to step (a) if the number is greater than one;  
 13 (e) if the number is equal to zero:  
 14 (e1) for each peer of the current node that has a local  
 15 port to the current node on, turning off said peer's local port to the  
 16 current node and adding said peer to the queue; and  
 17 (e2) setting the routing tree membership status of the  
 18 current node to non-member; and  
 19 (f) if the number is equal to one:  
 20 (f1) on the one peer coupled to the one local port,  
 21 turning off the peer's local port to the current node;  
 22 (f2) adding the one peer to the queue;  
 23 (f3) if zero peers have local ports to the current node on  
 24 and the group membership status of the current node is non-  
 25 member:  
 26 turning off the one local port of the current node  
 27 that is on; and  
 28 setting the routing tree membership status of the  
 29 current node to non-member; and  
 30 (f4) otherwise, setting the routing tree membership  
 31 status of the current node to SendOnly.

1 25. (Original) The system of claim 21, wherein said network node is  
 2 one of a channel adapter and a network switch.